ORDER

6190.7A

EARTS ENHANCEMENTS

SYSTEM IMPLEMENTATION PLAN

August 26, 1987

DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION

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Initiated By: APM-200

Foreword

This order sets forth the System Implementation Plan (SIP) for Enroute Automated Radar Tracking System (EARTS) Enhancement Program. It provides management direction for the establishment of Enhanced EARTS as a two phase effort. Phase 1 consists of hardware additions and Mosaic software to enable combination of available radar coverages to present one large picture from several smaller pictures. After Mosaic is accepted the system software will be further modified to provide Minimum Safe Altitude Warning and Conflict Alert capabilities (MSAW/CA). These enhancements will keep the EARTS system viable until replaced by the Advanced Automation System.

FOR James R. Etgen
Director, Program Engineering
and Maintenance Service

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CHAPTER 1. GENERAL

1. PURPOSE. This order transmits the enhanced EARTS System Implementation Plan (SIP) for execution.

2. DISTRIBUTION. This order is distributed to division level within the Program Engineering and Maintenance, System Engineering, Acquisition and Materiel, Air Traffic Operations, and Air Traffic Plans and Requirements Services at Washington headquarters; to division level at the FAA Technical Center and Mike Monroney Aeronautical Center; to division level in the regional Air Traffic and Airway Facilities divisions; and to the Air Traffic and Airway Facilities offices at the Air Route Traffic Control Centers (ARTCCs).

3. CANCELLATION. Order 6190.7, EARTS Enhancement System Implementation Plan dated 10/31/86 is canceled.

4. BACKGROUND.

a. EARTS-MSAW/CA software and hardware procurement was initiated by APM-210 in 1982, in response to Air Traffic Control requirements. The program provides EARTS with many functions currently used at 9020 equipped NAS En Route Centers (ARTCCs). In addition, EARTS-M will have track-all capability, improved intersensor data linking, enhanced interfacility communication and on-line radar certification capability.

b. EARTS-M software expands EARTS radar handling capacity to 15 sensors and provides Mosaic capability for geographical areas up to 2,048 NMI x 2,048 NMI. When MSAW/CA software is added in the 1987-1988 timeframe, EARTS facilities will have full NAS en route and terminal capabilities.

c. EARTS-MSAW/CA system installation, checkout and acceptance will involve both contract and FAA personnel. FAA support of this activity will be centered around a Test Manager at the FAA Technical Center and ATR-200 implementation at each site.

d. This order implements the EARTS Enhancement Project (1-04). EARTS Enhancements is a two state project consisting of EARTS Mosaic and EARTS-M MSAW/CA. EARTS Mosaic is in the late stages of implementation and is treated in the order accordingly. EARTS-M MSAW/CA is in the system development phase and therefore received primary emphasis.

5. SUMMARY OF CHANGES. EARTS Mosaic and EARTS MSAW/CA have been combined as one program vs two separate programs described in order 6190.7. This revision reflects changes necessary to accomplish this.

6. REQUEST FOR INFORMATION. The program manager for this order is the Manager, En Route Automation Program, APM-210. Any requests, suggestions, or comments should be directed to that office.

CHAPTER 2. PROGRAM MANAGEMENT

7. INTRODUCTION. The overall technical management of the EARTS Enhancement Program is the responsibility of the ATC Automation Division, APM-200, and in particular, the En Route Automation Program, APM-210. This organization will accomplish the management task within the guidelines provided by agency policies, procedures, and directives. A member of this program is designated EARTS enhancement program manager and is the single focal point for all program activities. Following acceptance of EARTS-Mosaic with MSAW/CA by ATR-200, field implementation will become an ATR-200 responsibility with technical support from UNISYS.

8. CONTRACT MANAGEMENT.

a. A contracting officer (CO), designated in ALG-311, performs the general contract management activities of the monitoring of contractor schedules, problem reports and solutions, meeting attendance, inspections, in-progress review conduct, and all other activities concerned with assuring that the terms of performance under the contract are met. The CO is the only person authorized to make changes that will affect prices, deliverables, or schedules.

b. A technical officer (TO), designated in APM-210, provides technical guidance and direction to the contractor within the scope of the contract. The TO assures that the contractor has access to technical documentation, appropriate data bases, and sources of information relative to government furnished equipment (GFE). The TO does not have the authority to make any changes in the provisions of the contract or the requirements of the specification.

9. WASHINGTON STAFF PROGRAM MANAGEMENT. For the Program Engineering and Maintenance Service to accomplish its assigned mission, coordination must be effected with all offices, services, centers, the region, and other organizations that have substantive responsibilities for acquisition and implementation. The responsibilities enumerated below must be met to ensure the timely completion of all actions that make up the complete package.

a. Program Engineering and Maintenance Service (APM).

(1) Communications and Surveillance Division, (APM-300) shall:

a. Provide the CD-2 eventually, and ASR-9 for respective EARTS ARTCCs.

b. Provide technical advice on the CD installation and its integration into the system with particular emphasis on the remote maintenance monitoring aspects of the system.

c. Provide technical advice on the MAR (minimally attended radar) beacon mod installation and its integration into the system.

(2) National Automation Engineering Field Support Sector (APM-160) shall:

(a) Participate in the analysis of the digitized data from any and all of the MAR sites, the Sandspit (Canadian) radar systems, and any other FAA designated radar/beacon system in Alaska.

(b) Be responsible for field support for the Sandspit reformatter installed at the Anchorage ARTCC.

(c) Provide data reduction to the region on a 24 hour turnaround to allow timely completion of required flight checks.

(3) ATC Automation Division (APM-200) shall:

(a) Have overall headquarters facilities and engineering program management responsibility for EARTS Enhancements.

(b) Provide the software necessary to reformat the MAR digitized data for input into the EARTS.

(c) Arrange for the Sandspit sensor to transmit digitized data to the EARTS in acceptable format.

(d) Provide software necessary to allow the EARTS to accept a total of 15 sensors.

(e) Provide software enhancements as are deemed necessary and approved by ATR-200. If enhancements are out of scope of an existing contract, ATR shall indicate priority for funding the enhancements, source of funds, and reprogramming if necessary.

(f) Provide configuration management until successful acceptance at FAA Technical Center.

(4) Communication and Facilities Division, APM-500, shall produce and furnish to the region the appropriate modems needed to accept the digitized radar data from MAR sites, Sandspit, and all other radar sites that provide input to Anchorage ARTCC (2 EARTS systems), Honolulu ARTCC (1 EARTS system), Nellis AFB range control (1 EARTS system), and San Juan ARTCC (1 EARTS system).

(5) Engineering Division, FAA Technical Center, ACT-100, shall provide contract and technical support to ATC Automation Division.

b. Associate Administrator for Air Traffic.

(1) Systems Plans and Program Division (ATR-100) shall:

(a) Evaluate and validate system requirements.

(b) Allocate required plan view displays.

(2) Procedures Division (ATO-300) shall provide standards and requirements, and verify that air traffic operational requirements are met.

(3) Automation Software Division, ATR-200, shall:

(a) Support maintenance of software programs after development is complete and initial operating capability has been effected.

(b) Participate in the development of system shakedown and operations changeover plans with the regions.

(c) Provide technical coordination and support the EARTS program office technical officer (TO) on matters relating to ATC functions and to operational requirements for intersystem interfaces.

(d) The EARTS enhancement functions require a data base consisting of a digital terrain map with associated altitudes. In order for the data to be available at the proper time, EARTS site data definition shall be controlled by ATR-200. NAS-MD-326, Adaptation Collection Guidelines for the en route system is used as a guide for the EARTS Terrain data formats. ATR-240 has issued a Site Program Bulletin, dated May 30, 1986, Subject: CA/MSAW Data Collection Bulletin Number: 7. The definition of the EARTS site adaptation and MSAW warning areas is a facility air traffic operations responsibility.

(e) Accept software from APM-210 for air traffic sevice and implement operationally.

c. Office of Flight Standards (AFS). AFS shall provide staff assistance to the regions in the development of required plans for system flight checks, as required.

d. Acquisition and Materiel Service (ALG). ALG shall:

(1) Provide all necessary procurement actions and enter into contract(s) between FAA and contractor(s) for system hardware and related items as necessary.

(2) Provide contract administration at FAA headquarters and in-plant.

(3) Provide industrial engineering support and production surveillance of program management and contract administration.

(4) Determine the adequacy of contractor's quality and reliability programs and inspection systems; furnish administrative contracting officer for in-plant contract administration; furnish quality reliability officer for in-plant quality and reliability assurance; conduct inspections and witness factory tests; and accept or reject systems and equipment at contractor's plant pursuant to the terms and conditions set forth in the contract.

e. Office of Personnel and Technical Training (APT). APT shall provide technical training as may be required in support of EARTS enhancements.

f. Office of Aviation Policy and Plans (APO). APO shall provide assistance in developing policy for major new issues that are encountered.

10. REGIONAL PROGRAM MANAGEMENT. Each region has appointed an EARTS project officer. The names of these project officers are listed in figure 2-1. ATR-200 has appointed a key site team manager to implement the operational program at each site. Key site team manager is listed in figure 2-1. Duties of team manager will be explained in paragraph 10.

a. Regional Airway Facilities divisions shall:

(1) Provide program management for all regional site preparation work necessary to support EARTS enhancements.

(2) Act as interface for all matters encountered at the facility needing Washington office resolution.

(3) Provide engineering support as needed.

b. ARTCC/Combined Center Radar Approach Control (CERAP) AF shall:

(1) Provide onsite resident engineers at the respective EARTS ARTCC/CERAP to accept contractor installed EARTS hardware.

FIGURE 2-1.
MSAW/CA Project Officers/Test Team Managers

Region	Project Officer	Site	Key Site Test Team Man.	Site Representative
Atlantic City		FAA Technical Center	ATR 245	Y. Chiu
Alaska	J. Schave	Anchorage	ATR 245	M. Keller
Southern	T. C. Meuninck	San Juan	ATR 245	A. Colberg
Western Pacific	Bruce Greer	Nellis	ATR 245	D. Eaves
		Honolulu	ATR 245	A. Roundy

(2) Through existing staff personnel provide assistance to AT for maintenance, support and site adaptation for all existing software associated with EARTS including future enhancements such as reformatters and MSAW/CA.

(3) Keep regional Airway Facilities assessed of project progress and identify, in a timely manner, any schedule slippages.

c. Regional Air Traffic divisions shall:

(1) Coordinate with regional Airway Facilities divisions in development of a site implementation plan.

(2) Assist the regional Airway Facilities division in site preparation on a timely basis in consonance with the site implementation plan.

(3) Provide, as conditions allow, regional staff coordination to adjust to training, testing, and operational needs of the system.

(4) Provide input to the EARTS System Implementation Plan and respond to planning activities that apply to the region.

(5) Participate in the development of system shakedown test.

(6) Assist the facility in conducting system shakedown and operations changeover testing in accordance with the requirements of the test plans for these functions.

(7) Provide support and approval of planned flight activities required to test the system within regional jurisdiction, as required.

(8) Assure issuance of Notice to Airmen (NOTAM) actions, as required, for flight advisory of test activities associated with the system.

(9) Assure that appropriate FAA/military local onsite agreements are reached.

(10) In coordination with the regional Airway Facilities divisions, conduct the final joint acceptance inspection (JAI) and the formal commissioning.

(11) Assign a regional Air Traffic representative to serve as the Air Traffic focal point for facility/region communications.

(12) In coordination with the regional Airway Facilities divisions and the facility, establish a Facility Integration Group (fig). The fig is to be made up of designated onsite AT and AF personnel who are experienced in the

implementation of electronic and/or automation systems. The regional Air Traffic divisions will assign a representative as member of fig. Personnel assigned to the fig are to be engaged in test monitor activities prior to IOC and are to be actively engaged in test activities subsequent to IOC. The fig will provide a facility coordinating body for implementation and operational cutover to EARTS-M with MSAW/CA.

d. EARTS Site AT shall:

(1) Coordinate with the Airway Facilities sector and the region in development of a site implementation plan.

(2) Assist the Airway Facilities sector and the region in site preparation on a timely basis in consonance with the site implementation plan.

(3) Provide, as conditions allow, adequate staffing to adjust to training, testing, and operational needs of the system.

(4) Provide input to the EARTS System Implementation Plan and respond to planning activities that apply to the facility.

(5) Participate in the development of system shakedown test plan and develop the operations changeover test plan.

(6) Participate with the Airway Facilities sector and the region in conducting systems shakedown and supervise the operations changeover testing in accordance with the requirements of the test plans for these functions.

(7) Coordinate and support planned flight activities required to test the system, as required.

(8) Issue Notices to Airmen (NOTAM), as required, for flight advisory of test activities associated with the system.

(9) Assure that appropriate FAA/military local onsite agreements are in effect.

(10) Participate in the final joint acceptance inspection (JAI) and the formal commissioning.

(11) Assign a facility representative to serve as the focal point for facilities/sector/region communications.

(12) In coordination with the Airway Facilities sector and the region, establish a Facility Integration Group. Assign representatives as members of Facility Integration Group. Personnel assigned to the fig are to be engaged in test monitor activities prior to IOC and are to be actively engaged in test activities subsequent to IOC.

(13) Define site adaptation and MSAW warning areas, mapping data, and provide as required.

e. ARTCC/CERAP AF shall:

(1) Provide personnel for support of hardware and software testing.

(2) Certify hardware.

(3) Make sure hardware is available during all testing.

11. TEST TEAM MANAGERS RESPONSIBILITIES.

a. The test team manager shall be responsible for assuring that the EARTS facilities and equipment site preparation activities are complete and acceptable before the start of the EARTS enhancement modification.

b. The test team manager for EARTS test activity will be the focal point for FAA involvement in onsite test and acceptance of EARTS-M with MSAW/CA software.

c. Major responsibilities will include:

(1) Coordinating with APM-210 for necessary support and other ATR agencies as appropriate.

(2) Maintenance and weekly distribution of the test manager log.

(3) Coordinating of FAA test support activity.

(4) Approval of test starts.

(5) Participation in evaluation of test results.

(6) Review of test reports.

(7) Certify satisfactory completion of onsite testing.

(8) Verification and documentation of significant software problems.

(9) Site approval of delivered software problem resolution.

(10) Maintenance of the overall test report.

(11) Acceptance of FAA delivered operational software and documentation.

d. Throughout the EARTS test activity the test team manager should coordinate to ensure the test will not impact air traffic operations and be conducted only when approved by the assistant manager in charge.

e. The duties of the test team manager will be complete after the EARTS hardware/software additions have been installed, the testing outlined herein has been completed, and a JAI has been conducted on the facilities and equipment work done at the site. Subsequent software deliveries from National Terminal Field Support/Maintenance Branch which will initiate some or all of these enhanced features shall be handled in the same manner as the present EARTS software deliveries

12. CONFIGURATION MANAGEMENT.

a. The contractor has a configuration management program in accordance with to FAA Standard 021, Configuration Management (Contractor Requirements) to ensure positive control of the enhanced EARTS system throughout the life of the contracts. This program provided for the orderely development and documentation of a detailed definition of the hardware and software configuration during the design and development phases of the system upgrade.

b. Configuration control of the enhanced EARTS system is exercised by APM-210 in accordance with FAA Order 1800.8E, National Airspace System Configuration Management until the system acceptance tests at the FAA Technical Center has been successfully completed. After these tests are completed, the enhanced EARTS system will be baselined and put under formal agency configuration management by ATR-240 in accordance with FAA Order 1800.8E.

13.-15. RESERVED.

CHAPTER 3. SYSTEM DESCRIPTION

16. GENERAL.

a. The basic EARTS operational system consists of hardware, software, installation, testing, reliability features and maintainability features necessary to provide functional and operational capabilities for a fully integrated system. The EARTS system provides for the narrow band processing of both long range radar and terminal radar for display on fully digital GFE plan view displays (PVDs).

b. The EARTS systems installed at Anchorage, Alaska, Honolulu, Hawaii, San Juan, P.R. and Nellis AFB are designed and built to provide for a modular expansion to accommodate reasonable increases in air traffic control requirements over the next 10 years. The systems provide for a 24 hour daily operational capability through the use of the hardware and software resources available in the system.

c. A basic EARTS system configuration is shown in figure 3-1. The EARTS enhancement consists of EARTS mosaic software and MSAW/CA software as well as the necessary hardware to provide increased processing capability needed for these software programs. EARTS MOSAIC System Configuration is shown in figure 3-2.

17. EARTS MOSAIC.

a. In contrast to the current EARTS system, EARTS-M allows any controller to view any part of the entire radar coverage area, no matter which radar (or combination of radars) covers that area. This is accomplished by taking the data from all radars and combining it into a large map through the use of a sterographic projection. A sterographic projection maps points on or near the surface of the earth by projecting them onto a plane tangent to the earth. The point of tangency is chosen mathematically. For minimum distortion, it should be as near as possible to the points to be projected.

b. In the mosaic system, one large picture is made from several small pictures (as is often done with aerial photographs). The EARTS-M project alters existing EARTS software and writes new software as necessary to change EARTS to a mosaic system.

c. Although the acronym EARTS implies an enroute (not in the immediate vicinity of an airport) system, EARTS tracks aircraft from takeoff to landing. This could increase the complexity of air traffic control, since traffic density and aircraft maneuvers are quite different near airports from what they are en route. Complexity could also increase due to EARTS having both short range and long range radar, with their very different scan times

FIGURE 3-1. BASIC EARTS

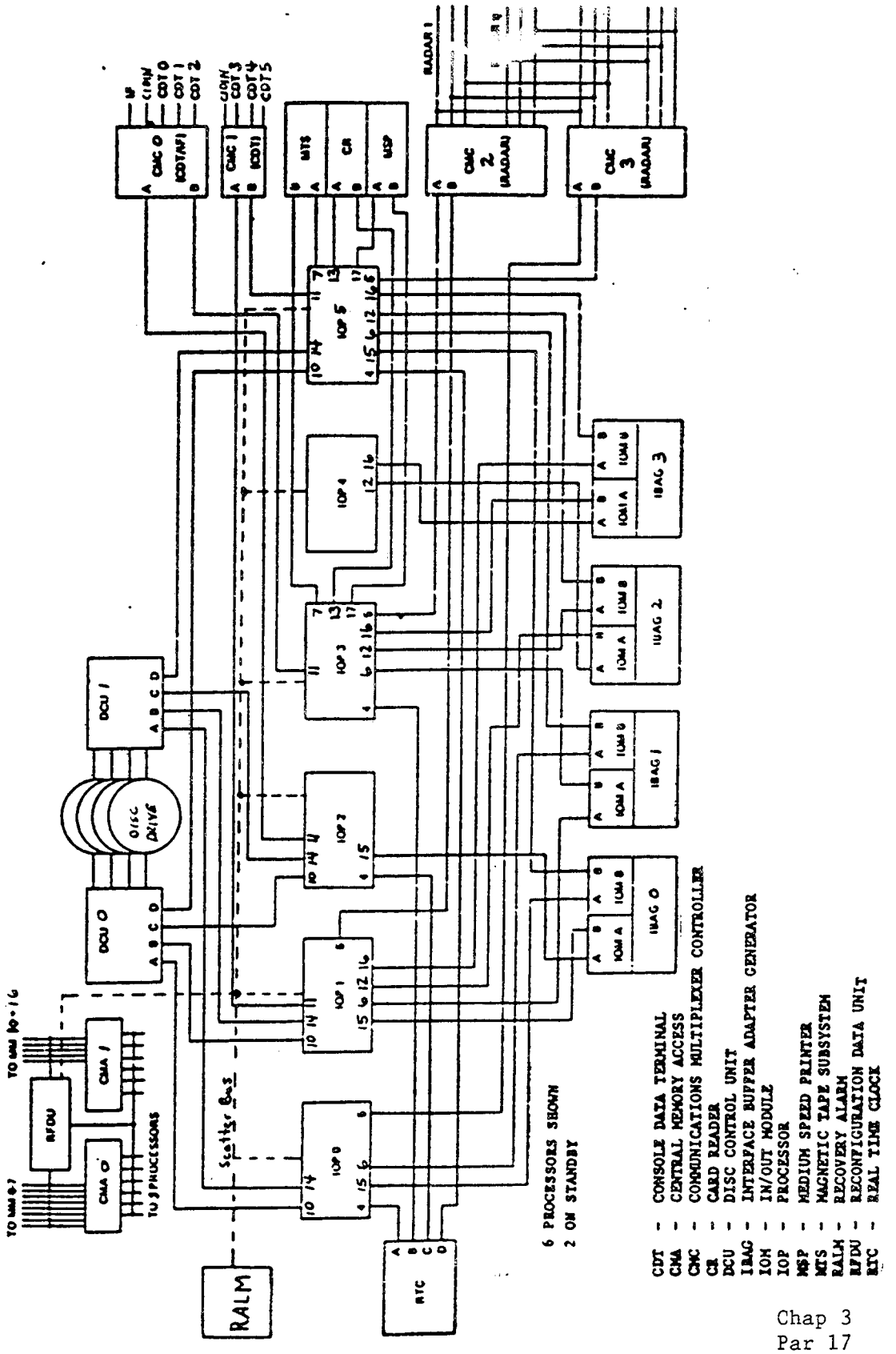
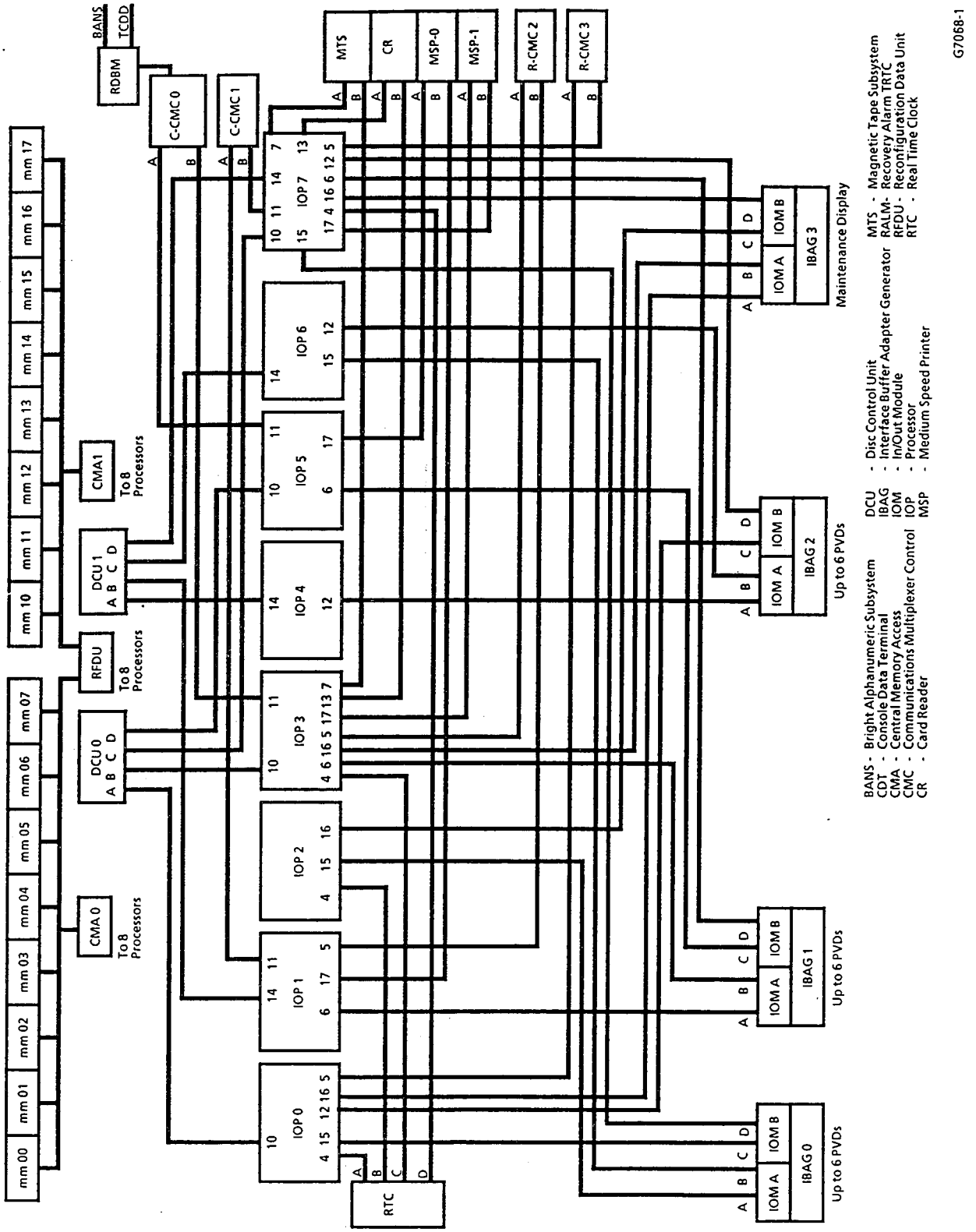


FIGURE 3-2. EARTS MOSAIC CONFIGURATION



(five seconds and 12 seconds, respectively). Also, the calculations needed to transform data from the polar coordinates of radar to the rectangular coordinates of the sterographic plane will introduce a different form of error in the new mosaic system. EARTS-M software addresses these concerns.

d. EARTS is a multiprocessor system that has eight processors EARTS now requires four. EARTS-M will require only six, including two for redundancy and off-line application. EARTS MSAW/CA will require seven. This allows future expansion of the system.

e. EARTS Mosaic System is composed of the following major sub Functions:

(1) Multiprocessor Executive Control (NAS-MD-675)

(2) Radar Input Processing (NAS-MD-676)

(3) Track Processing (NAS-MD-677)

(4) Controller Keyboard Processing (NAS-MD-678)

(5) Display Output Processing (NAS-MD-679)

(6) Interfacility Data Transfer (NAS-MD-680)

(7) Bulk Store Flight Plan Processing (NAS-MD-681)

(8) Console Data Terminal Input Processing (NAS-MD-685)

(9) Off-line Programs (NAS-MD-686)

(10) System Recovery (NAS-MD-687)

(11) Continuous Data Recording (NAS-MD-688)

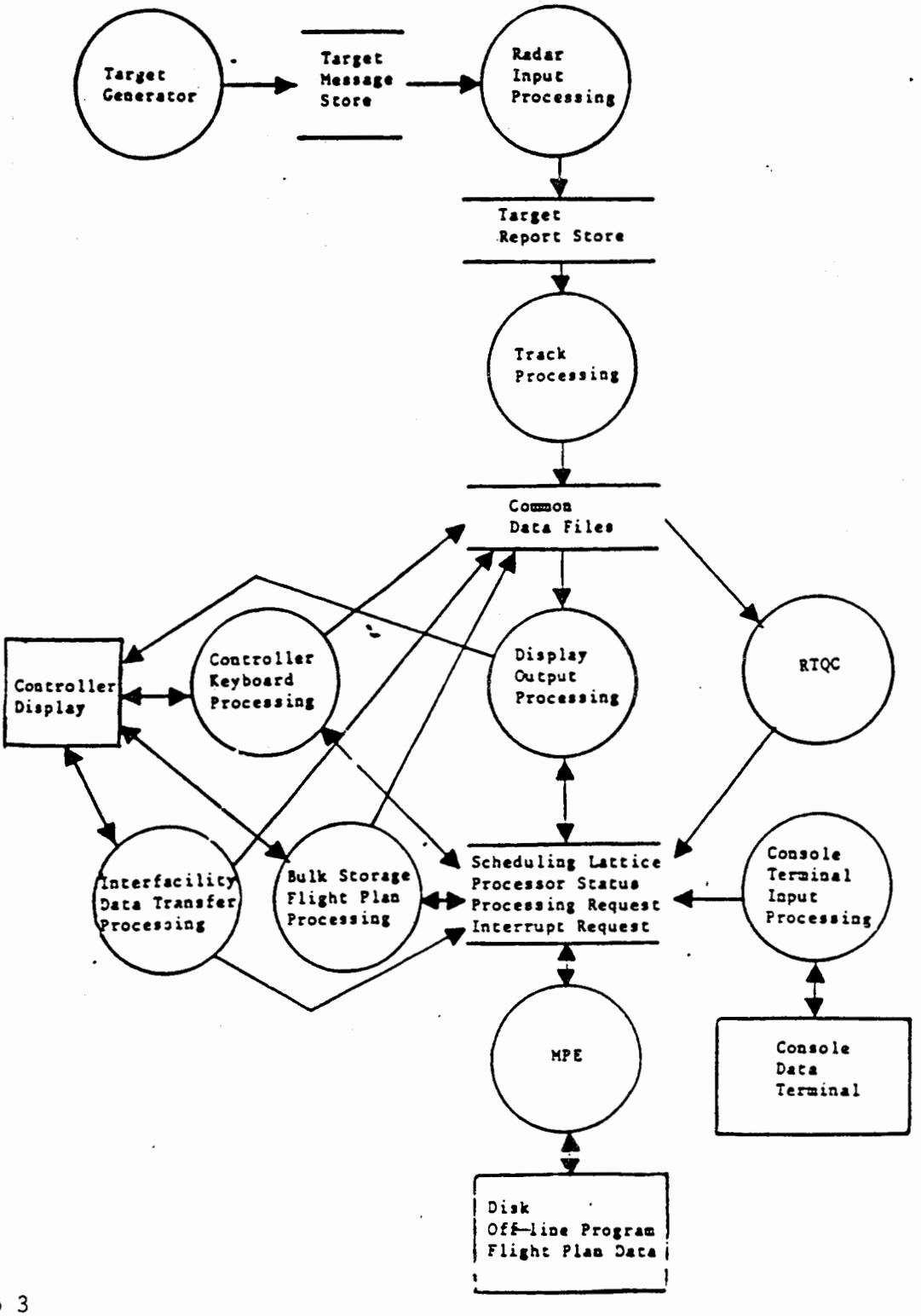
(12) EARTS Target Generator (NAS-MD-689)

(13) Real-time Quality Control (NAS-MD-690)

(14) On-line Certification and Diagnostics (NAS-MD-691)

f. The basic functional capabilities and interrelationships of each of these subsystems are discussed in the remainder of this section. More detailed description is contained in the NAS-MD referred above. Figure 3-3 shows EARTS Mosaic data flow.

FIGURE 3-3. DATA FLOW DIAGRAM FOR EARTS MOSAIC SYSTEM



(1) MULTIPROCESSOR EXECUTIVE CONTROL. The Multiprocessor Executive (MPE) provides overall control of the Multiprocessor Data Processing Subsystem (MDPS), handles the execution of operational programs (tasks), detects system failure, initiates system recovery, and controls input/output to the medium speed printer (MSP), console data terminal (CDT), communications multiplexer controller (CMC), and disk. To achieve optimum efficiency within an MDPS, task workloads must be properly distributed among the processors; to achieve data protection and integrity, tasks must be scheduled so that simultaneous data fetches and memory accesses are minimized. The MPE system uses a task network describing alltasks that are successoes to a given task. The MPE is composed of the following modules:

(a) Initializer.

(b) Scheduler.

(c) Executive Services.

(d) Interrupt Control.

(e) Debug.

(2) RADAR INPUT PROCESSING.

(a) Radar Input Processing accepts all radar information entered into the data processing subsystem (DPS). The radar information is sent from the radar digitizer in the form of messages. The messages from a radar digitizer enter the DPS from a communications multiplexer controller (CMC). The CMC multiplexes the data from all sensors onto one externally specified index (ESI) channel. Radar input processing performs all functions required to accept and control the multiplexed radar data from the sensors in an EARTS system.

(b) The radar input processing function acts as an intermediate processor of radar data, transferring information from the radar digitizer to a form usable by other software routines. The functions performed by radar input processing include sector monitoring, message processing and interrupt processing.

(3) TRACK PROCESSING. Track Processing maintains a correct association between the target reports generated by radar input processing and the alphanumeric data identifying an aircraft on each controller's display console. This is accomplished by scan-to-scan correlation. A priority system based on the current position of the radar antenna is used to determine when the various tracking functions are to be performed. The following functions are enabled for execution each time a new sector is ready for processing:

(a) Primary/Secondary Correlation.

(b) Initial/Trail Correlation.

(c) Process Unused Reports.

(d) Cross-Referencing.

(e) Prediction.

(f) Duplicate Track Linking.

(4) CONTROLLER KEYBOARD PROCESSING. Controller keyboard processing provides the primary controller-system interface. Keyboard messages are used to manually initiate and terminate control of tracks, to modify track data or track controller, to initiate and accept aircraft hand offs, to reposition the presentation of alphanumeric information, to enter data such as time and altimeter setting, and to request the printout or display of system data. Keyboard messages also control certain operational functions, including external facility input, bulk store input, automatic offset, and system configuration selection.

(5) DISPLAY OUTPUT PROCESSING.

(a) Display output processing outputs track and system information to a maximum of 24 displays. The capability exists to output this information to plan view displays (PVD), BRITE alphanumeric subsystem (BANS) displays and tower cab digital displays (TCDD). These displays support air traffic control in both a local and remote environment.

(b) Track and map data are displayed in either a mosaic or sensor-oriented format. The mosaic display presentation allows display of track and vector information from a combination of short and long range radars, using a common system plan. The sensor-oriented display presentation allows display of short range radar data in support of terminal area air traffic control.

(6) INTERFACILITY DATA TRANSFER. The interfacility data transfer function is used for the transmission of data messages between EARTS and ARTCC or ARTS facilities. The messages contain operational flight data, track data and test data. This information permits various interfacility functions to be performed, such as track hand offs between automated facilities. Interfacility data transfer is not constrained by the different models of the ARTCC and ARTS systems.

(7) BULK STORE FLIGHT PLAN PROCESSING. Prestored flight plan information residing on a bulk store device (disk) is available for use by the EARTS system. The flight plans are ordered sequentially by time for all

flights that will arrive at or depart from designated airports within the EARTS area on a regular scheduled basis. Bulk store flight plan processing reads these disk flight plans and forms a data base upon which other functions (primarily display output) rely. Processing of the flight plan data is requested by a keyboard action.

(8) CONSOLE DATA TERMINAL INPUT PROCESSING. Console data terminal input processing (CTIP) processes all TK (task) input messages entered by an operator at either of the two console data terminals (CDT) defined as system monitor stations (SMS). All input from an SMS is initially handled by the MPE, which verifies the message as a TK message. CTIP then performs the following functions as requested by the input message:

(a) Changes the status of a controller display.

(b) Analyzes the current system workload.

(c) Controls on-call functions.

(d) Invokes Real Time Quality Control (RTQC).

(9) OFF-LINE PROGRAMS. Off-Line programs are utility programs that run on an off-line IOP or UNYSIS 1100 and are independent of the operational programs. The off-line programs consist of:

(a) Builder Utility Program (BUP).

(b) CDR Editor.

(c) Flight Plan Maintenance Program (FPMP).

(d) Target Generator Scenario Off-line Program (SCOFF).

(e) Geographic Map Write.

(f) Common Digitizer Simulation (CDSIM).

(g) Display Simulation.

(h) Interfacility Test.

(i) Data Base Generation Program (DBG).[1]

(j) Sterographic Projection Adaptation Program (SPA).

(k) Geographic Data Plotter (PLOT).

(1) Memory Mapper.[1]

[1]Run on UNYSIS 1100 only

(10) SYSTEM RECOVERY. System Recovery provides for the smooth transition from a failed system to an operational system. The functions of system recovery are to isolate the elements responsible for system failure and to restore the system to a level similar to that which existed prior to the failure. To isolate the failed elements of a system, diagnostic tests are performed on the data processing subsystem (DPS) and memory modules. The operational program is then reloaded, excluding those elements determined to be inoperable. Critical data, which were recorded prior to the failure, are then reloaded. Thus, when program operation resumes, the major system functions (tracking, display, etc.) can efficiently return to their pre-failure state.

(11) CONTINUOUS DATA RECORDING. Continuous data recording (CDR) provides continuous recording of operational program data on disk. This information is useful for reconstructing situations that occur during normal air traffic control operations for incident analysis or system debugging. Certain data types may be specified for on-line extraction through display keyboard entries or console data terminal (CDT) entries. The off-line CDR Editor is used to access the extracted data on disk for printing on the medium speed printer (MSP).

(12) EARTS TARGET GENERATOR. The EARTS target generator (TG) generates simulated targets for testing and training. Unique target generator commands are used to initiate and control these simulated targets.

(13) REAL-TIME QUALITY CONTROL. Real-time quality control (RTQC) monitors incoming radar data. The functions performed include status message monitoring, test message monitoring, radar data counts, registration analysis, collimation analysis, permanent echo verification (PEV) and failed radar analysis (FRA). Summary printouts of the accumulated information are output on the console data terminal (CDT) and medium speed printer (MSP).

(14) ON-LINE CERTIFICATION AND DIAGNOSTICS.

(a) The set of programs covered by on-line certification and diagnostics provides real-time (on-line) monitoring and confirmation of the major subsystems of the EARTS operational program. The programs included in the set are:

1. OLC - On-Line Certification

2. EQARS - EARTS Quick Analysis of Radar Sites

3. RAOT - Radar Adapter Operability Test

4. IDOT - IBAG/Display Operability Test

Each of these programs resides on disk and is requested for loading into memory by a Console Data Terminal (CDT) entry. These programs enhance the capability of the operational program but are not necessary for the execution of any task. The data flow diagram for the Mosaic system is shown in Figure 3-3. EARTS MOSAIC system capacity in illustrated in Figure 3-4.

18. EARTS MSAWA/CA

a. MSAW/CA enhancement will be installed approximately 1 year after Mosaic S/W and is composed of following major functions:

(1) Conflict Alert (NAS-MD-672)

(2) Minimum Safe Altitude Warning/Altitude Tracking (NAS-MD-684)

b. The basic functional capabilities are discussed in the remainder of this section. More detailed description is contained in the NAS MDs referenced above.

(1) Conflict Alert. Provides a visual and aural warning to a controller in the event an aircraft under his control and another are currently in or predicted to be in a potentially hazardous proximity to each other. It accomplishes this by monitoring current and projected separation distance between pairs of elibible aircraft. A conflict alert data flow is depicted in Figure 3-5.

(2) Minimum Safe Altitude Warning (MSAW) and Altitude Tracking. Provides a system which shall monitor aircraft terrain and obstruction separation and generate, when appropriate, a visual and aural warning which will alert controllers to advise aircraft of evasive action necessary to resolve potential conflicts. Altitude Tracking derives estimates of the aircrafts situation in the vertical dimension (altitude and altitude change rate) from mode C reports or controller entered reported altitude which have been associated by track correlation. MSAW/altitude tracking data flow is depicted in figure 3-6.

19.-20 RESERVED.

FIGURE 3-4 SYSTEM CAPACITY

The following table describes the capacity of the EARTS mosaic system. It provides insight into the system's operations at near capacity. The table can also be used to derive a system capacity test at different test sites.

Description	Value
Number of Active Data Files	700
Number of Flight Data Files	400
Number of Sensors (beacon search and beacon only)	15
Number of Displays (PVD, BANS and TCDD)	24
Number of IBAGs	4
Number of IOPs (Six on-line processors, two off-line)	8
Number of Data Blocks (full datablock, limited datablock) per display	76
Number of Single Symbols per Display	210
Number of Airports and Fixes	1-63
Number of Configuration	5
Number of Configuration Items	100
Length of Configuration Table	400
Number of Target Reports/Sensor	100
Length of Clutter Map Input Table/Sensor	40
Length of Weather Inner Map Input Table/Sensor	100
Length of Weather Outter Map Input Table/Sensor	200
Number of Altimeter Stations	64
Number of Beacon-Search Sensors	10

FIGURE 3-4. SYSTEM CAPACITY (CONTINUED)

Number of Beacon Only Sensors	5
Number of Radar Receiver Adapters	32
Number of Radar Sort Boxes in X Dimension	100
Number of Radar Sort Boxes in Y Dimension	75
Number of Beacon Reports/Sensor	115
Number of Radar Reports/Sensor	100

FIGURE 3-5. DATA FLOW FOR CONFLICT ALERT

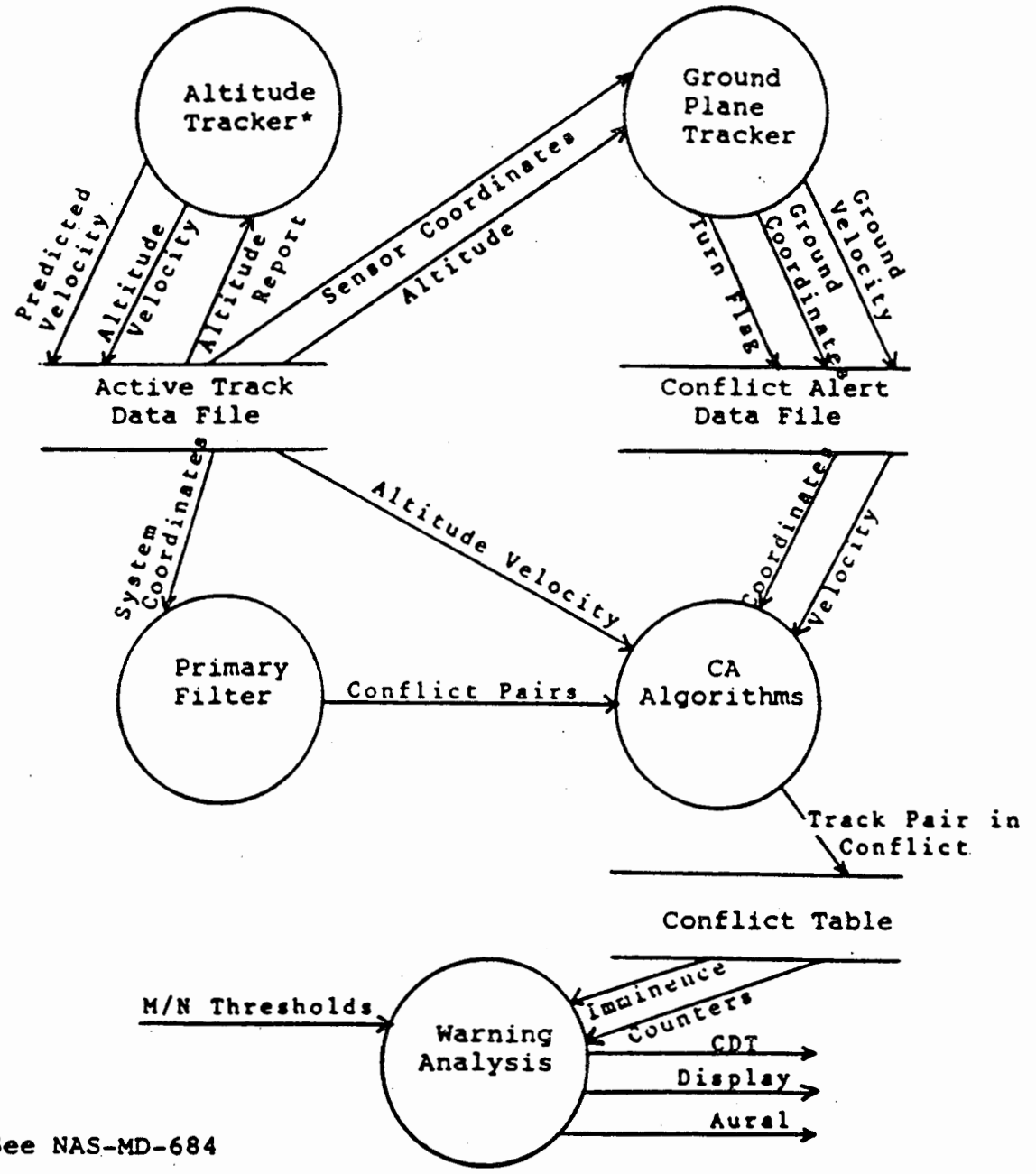
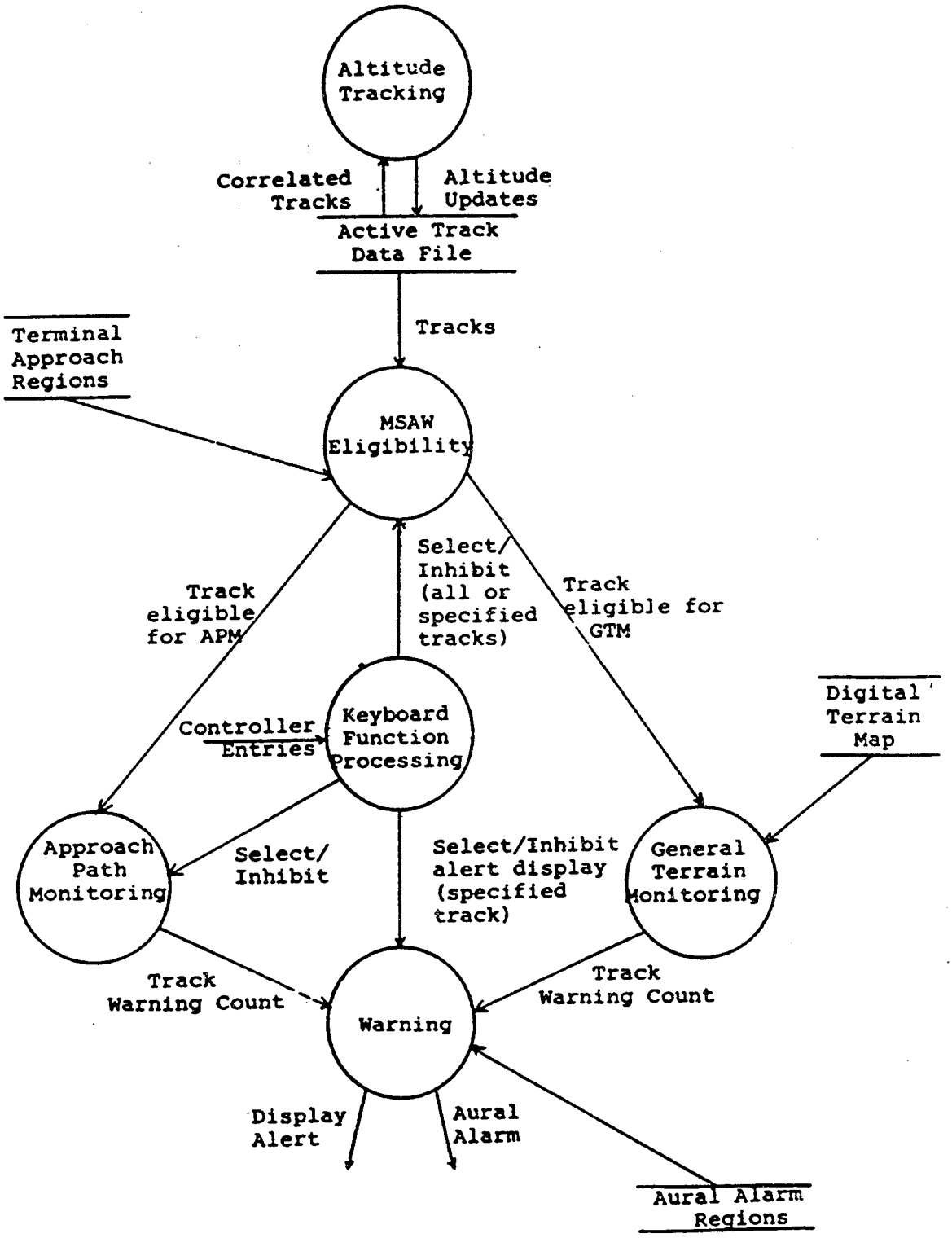


FIGURE 3-6. MSAW/ALTITUDE TRACKING DATA FLOW DIAGRAM



CHAPTER 4. ENHANCED EARTS IMPLEMENTATION

21. GENERAL. Planning charts for the enhanced EARTS implementation are provided in figure 4-1.

22. SITE PLANNING AND SITE PREPARATION.

a. The site activities described in this section include the site survey activities and installation of hardware under provisions of contract DTFA01-81-C-20010 and ATC 24032 installation and cutover plan for follow-on EARTS system dated May 85 (final).

b. Site surveys have been conducted. No major problems are apparent. Site installation is in progress.

c. Site Preparation.

(1) Site 1 - FAA Technical Center. ACT-600 is responsible for the engineering and installation of additional EARTS capable equipment using current directives.

(2) Anchorage, San Juan, Honolulu. The regional Airway Facilities divisions associated with each site is responsible for the engineering (including cabinet location), inventory and inspection, cabinet placement, and installation of power and grounding to the additional EARTS equipment per ATC 24032. Nellis AFB site will be installed per ATC 24032 under supervision of 554 range group.

23. THE IMPLEMENTATION PROCESS.

a. EARTS-M hardware was installed under case file no. APM-210-EARTS-001, configuration control decision, N8329. Hardware installation required reconnection of several existing I/O peripheral cables. The specific cable changed required and the order in which they are to be made are contained in CCD N8329.

b. EARTS-M software is presently being tested under case file APM-210-EARTS-002. EARTS with Mosaic and MSAW/CA software will be installed under case file APM-210-EARTS-012 in the following order:

(1) Step 1.

(a) System demonstration was conducted at the FAA Technical Center based on the interim CPFS with change pages.

FIGURE 4-1. SIGNIFICANT IMPLEMENTATION EVENTS

	MOSAIC EQUIPMENT		MOSAIC SOFTWARE ACCEPTANCE		MOSAIC WITH MSAW/CA SOFTWARE DELIVERY	
	Delivery	Install	Start	Compl	Start	Compl
FAA Technical Center	Actual	Actual	Actual	Actual	Actual	Actual
Nellis AFB	Actual	Actual	Actual	Actual	8/87	8/87
Anchorage	Actual	Actual	Actual	Actual	10/87	11/87
Honolulu	Actual	Actual	Actual	Actual	9/87	9/87
San Juan PR	Actual	Actual	Actual	Actual	9/87	9/87

(b) The system demonstration was conducted by UNYSIS with FAA participants.

(c) Following final acceptance of MOSAIC software by ATR-200, MSAW/CA software will be baselined to the final MOSAIC software configuration by UNISYS.

(2) Step 2.

(a) The EARTS-M with MSAW/CA final system acceptance testing shall be conducted at the FAA Technical Center (FAATC). Testing at the FAATC will demonstrate the acceptability of system software vs. contract specifications and acceptability to air traffic.

(b) UNISYS will correct problems uncovered during key site acceptance testing to the satisfaction of the FAA. Problems will be classified as low medium or high priority for resolution. Problems classified as medium or higher will be fixed before proceeding to step 3. Results of the FAA approved final acceptance testing shall be forwarded to each EARTS facility to enhance the exchange of information between facilities.

(c) Satisfactory completion and FAA acceptance will conclude that contract requirements for system acceptance test were satisfied.

(3) Step 3.

(a) Following final acceptance testing of UNISYS delivered software at FAA Technical Center, ATR-200 will assume responsibility for combined EARTS-M with MSAW/CA software package and begin preparation for key site implementation at Nellis A.F.B. Key site testing will be conducted by ATR-240 with UNISYS technical assistnce. The key site test results shall be evaluated by ATR-240.

(b) FAA onsite testing conducted by ATR-240 will conclude that the onsite key site testing requirements were satisfied.

(4) Step 4.

(a) Facility testing of the operational system shall be conducted by the facility in accordance with established FAA procedures. Problems encountered during facility testing of the operational system shall be corrected by ATR-240/APM-160 with contractor support. Contractor support will be available for EARTS-MSAW/CA problem resolution through December 1990 subject to the availability of funds.

b. Completion of above described steps will result in operational system.

24-25 RESERVED.

CHAPTER 5. INTEGRATED LOGISTIC SUPPORT FOR THE EARTS ENHANCEMENT

26. Documentation. In addition to changes in existing documentation, the following publications will be added:

a.	NAS-MD-672	Conflict Alert
b.	NAS-MD-684	MSAW-Altitude Tracking

27. OPERATIONAL REQUIREMENTS. The operational requirements for the enhanced EARTS system will be the same as for the basic EARTS system.

28. PLANNING STANDARDS. The following FAA directives shall be used as standards and guidelines for EARTS enhancement program:

a.	1100.1A	FAA Organization - Policy and Standards.
b.	1100.134A	Maintenance of National Airspace System Automation Subsystems.
c.	1320.37A	Contractor-Developed Equipment Instruction Books.
d.	1380.40B	Airway Facilities Sector Level Staffing Standards System.
e.	1800.8E	National Airspace System Configuration Management.
f.	1800.30	Development of Logistic Support for FAA Facilities and Equipment.
g.	4250.9A	Field Inventory Management and Replenishment Handbook.
h.	4560.1A	Initial Provisioning for Support of Facilities, Facility Components, Aircraft and Avionic Equipment.
i.	4620.3C	Initial Support for New or Modified Equipment Installation.
k.	4800.2A	Utilization and Disposal of Excess and Surplus Personal Property.
l.	6000.18	Field Repair of Equipment.
m.	6020.2A	Joint Acceptance Inspection for FAA Facilities.

n.	6200.4C	Test Equipment Management Handbook.
o.	FAA-G-1210D	Provisioning Technical Documentation.
p.	FAA-G-1375B	Spare Parts - Peculiar for Electronic, Electrical and Mechanical Equipment.
q.	FAA-E-2552A	Technical Training Specification.
r.	FAA-E-2592A	En Route Automated Radar Tracking System (EARTS)
s.	FAA-E-2592A Supp 1	Mosaic Software For EARTS
t.	FAA-E-2592A Supp 2	MSAW/CA Software for EARTS

29. MAINTENANCE CONCEPT. The EARTS maintenance concept will not change with the implementation of the enhancement features. EARTS maintenance procedures and documentation will be revised to apply to the EARTS enhanced equipment. The maintenance plannig is as follows:

a. APM-160 will revise Order 6100.1, Maintenance of NAS En Route stage A Air Traffic Control System, to incorporate performance and certification standards for the enhanced EARTS features and will coordinate with other agency groups to revise qualification and classification standards for field maintenance personnel.

b. Long-range maintenance spare parts levels, field training, and documentation has been revised for the enhanced EARTS features. This revision took place with the help of the regions and other services.

(3) Planning for additional site support, in terms of contractor personnel, spares, additional test or operational equipment, and documentation shall be determined by APM-210 and other service personnel.

30. TRAINING. This section discusses the training required to maintain the enhanced EARTS system.

a. Responsibilities.

(1) Maintenance Engineering Division (APM-100). This division has established regional Airway Facilities (AF) training requirements, reviewed training plans developed by the FAA Academy, and assured timely accomplishment of training. Enhanced system will be maintained using same concept and procedures as present system.

(2) Office of Personnel and Technical Training (APT-300). This office assisted in the development of training proposals, review and approval of training plans, the selection of training methodology required, and the procurement and quality control of training deliverables.

(3) ARTCC EARTS Facilities. Schedule on-the-job training (OJT) and hands-on training (HOT) as dictated by operational requirements.

b. FAA Academy Training

(1) Training will be conducted by the FAA Academy using the following existing courses.

(a) 42033 Introduction.

(b) 42027 Data Processing Subsystem.

(c) 42025 Continuous Data Recording Subsystem.

(d) 42028 Data Acquisition Subsystem.

(e) 42024 Interface Buffer Adapter Generator System.

(f) 43467 EARTS Display Subsystem.

(g) 42021 EARTS System.

c. Modular Lecture Laboratory Training Course. The contractor will conduct a modular lecture laboratory training course at the locations and dates shown in figure 5-1. The course will cover maintenance of enhanced EARTS software package.

d. Initial Air Traffic Controller Training. Air traffic controller training will be conducted at EARTS locations by the contractor schedule shown in figure 5-1. The training will be designed to give the air traffic controller a complete understanding and sufficient skills to interpret and manipulate EARTS-MSAW/CA software keyboard entries and display characteristics. Continuation training will be conducted by air traffic trainees using course materials derived from initial training.

31. LOGISTICS.

a. Logistics Support. Support is required for all levels of maintenance for the system's programmed life cycle. The elements required for support are categorized as:

(1) Planned maintenance.

FIGURE 5-1. EARTS TRAINING

	Mosaic Software			MSAW/CA Software			
				Software Maintenance		Controller	
	Lecture (4 weeks)	Lab (3 weeks)	Controller (2 1/2 days)	Start	Finish	Start	Finish
				Proposed Dates			
FAA Technical Center	Actual	Actual	N/A	05/09/88	05/27/88	N/A	N/A
Anchorage	Actual	Actual	Actual	07/05/88	07/22/88	07/25/88	07/25/88
Honolulu	Actual	Actual	Actual	08/08/88	08/26/88	08/29/88	08/29/88
Nellis AFB	Actual	Actual	Actual	09/12/88	09/30/88	10/03/88	10/03/88
San Juan	Actual	Actual	Actual	10/17/88	11/04/88	11/07/88	11/07/88

NOTE: Onsite OJT in fall of 1987 will provide interim training to allow use of CA function.

(2) Personnel and training.

(3) Logistic information and data.

(4) Spares and repair parts.

(5) Tools and test equipment.

(6) Facilities.

(7) Transportation and handling.

b. Engineering Support Services.

(1) APM-160 at the FAA Technical Center is responsible for site support concerning hardware problems and improvements. Hardware discrepancy reports (hdr's) will be prepared by site personnel and submitted to APM-160 in accordance with FAA Order 1100.134A, Maintenance of National Airspace System Automation Subsystems, to report hardware problems. For software problems, program technical reports (ptr's) will be completed by site personnel and forwarded to ATC-560 for operational software support in compliance with paragraph 12 of FAA Order 1100.134A.

(2) Any changes resulting from these actions must be approved via the configuration management process. Changes required prior to 4th system installation shall be done by the contractor. In particular, approved hardware changes shall be installed by the contractor in accordance with electronic equipment modifications prepared by the contractor as required by FAA Order 1320.33B, Equipment Modification and Facility Instruction Directives.

c. Logistical Support During Hardware Installation.

(1) Problems with delivered cables are to be reported to APM-160 (FTS 482-6236) for resolution.

(2) Failures of printed circuit boards are to be reported to the Enroute Automation Program, APM-210, FTS 426-8596 in order that the failed board can be returned and a replacement can be obtained.

d. Logistical Support Following Hardware Installation.

(1) Failed printed circuit boards are to be repaired by the FAA ARTCC Airways Facilities personnel using the EARTS maintenance and diagnostic circuit board documentation, and board repair equipment of the facility.

(2) Repair parts are to be ordered from the FAA depot. All of the component parts for the enhanced EARTS hardware have been cataloged by the FAA Depot and are available for order.

(3) Any problems in the repair of the enhanced EARTS printed circuit boards, power supplies, and other equipments is to be reported to APM-160 (FTS 482-6236) for resolution.